

10/589315
F-896
JAP20 Rec'd PCT/PTO 14 AUG 2006

Amended Claims

1. Apparatus for preparing and supplying catalyst slurry to a polymerization reactor wherein polyethylene is prepared, comprising
 - one or more storage vessels (2) for containing concentrated catalyst slurry consisting of solid catalyst particles suspended in a hydrocarbon diluent or in a mineral oil,
 - a mixing vessel (3) for containing diluted catalyst slurry of a suitable concentration for use in a polymerization reaction, being connected with said storage vessels (2) by one or more conduits for transferring said catalyst slurry from said storage vessels (2) to said mixing vessel (3), and being provided with one or more conduits for transferring the diluted catalyst slurry from said mixing vessel (3) to said reactor (1), and
 - one or more conduits (4), connecting said mixing vessel (3) to a polymerization reactor for transferring said diluted catalyst slurry from said mixing vessel (3) to said reactor (1), whereby each conduit is provided with a membrane pump (5) for pumping said slurry to said reactor (1), which is controllable in function of the concentration of a reactant in said reactor (1).
2. Apparatus according to claim 1, wherein one or more conduits for transferring catalyst slurry from said storage vessels (2) to said mixing vessel (3) comprises diluent injection means.
3. Apparatus according to claim 1 or 2, wherein said one or more conduits for transferring catalyst slurry from said storage vessels (2) to said mixing vessel (3) comprise a first conduit (6) for transferring said catalyst slurry from a first storage vessel (2) to a mixing vessel (3) which is interchangeable with a second conduit (7) for transferring said catalyst slurry from a second storage vessel (2) to a mixing vessel (3) through lines (8) connecting said first means (6) with said second means (7).
4. Apparatus according to any of the previous claims, wherein said conduits (6, 7) for transferring said catalyst slurry from a storage vessel (2) to a mixing vessel (3), each are provided with a metering valve (9), provided downstream the connecting lines (8).
5. Apparatus according to claim 1 or 2, wherein each of said one or more conduits for transferring catalyst slurry from said storage vessels (2) to said mixing vessel (3) comprise a pump (50).

6. Apparatus according to claim 5, wherein said pump (50) provided on each conduit for transferring the concentrated catalyst slurry from said vessel (2) to the buffer vessel (3) comprises a progressive cavity pump.
7. Apparatus according to any of claims 1 to 6, further comprising flow measuring means (10) for measuring the catalyst flow rate provided on said conduit (4) for transferring the diluted catalyst slurry from said mixing vessel (3) to said reactor (1).
8. Apparatus according to any of claims 1-2 and 5-7, further comprising flow measuring means (10) for measuring the catalyst flow rate provided on said conduit for transferring catalyst slurry from said storage vessels (2) to said mixing vessel (3).
9. Apparatus according to any of the previous claims, further comprising a co-catalyst feeding system, for bringing a suitable amount of co-catalyst into contact with the catalyst slurry before injecting said catalyst slurry to said reactor, said system comprising a co-catalyst storage vessel (11) and a conduit (12) connected thereto for transferring said co-catalyst.
10. Apparatus according to any of the previous claims, wherein said conduit (4) is provided with a contact vessel (13) for enhancing the contact time of said co-catalyst with said catalyst slurry in said conduit (4).
11. Apparatus according to any of claims 1-10, wherein said polymerisation reactor (1) is suitable for preparing polyethylene, and preferably for preparing bimodal polyethylene.
12. Apparatus according to any of claims 1-4, 7 and 9-11, wherein said catalyst is a metallocene catalyst, preferably supported.
13. Apparatus according to any of claims 1-2 and 5-11, wherein said catalyst is a Ziegler-Natta catalyst having general formula MX_n , wherein M is a transition metal compound selected from group IV to VII, wherein X is a halogen, and wherein n is the valence of the metal.
14. Apparatus according to any of claims 1-13, wherein said co-catalyst is an organo-aluminium compound, being optionally halogenated, having general formula AlR_3 or AlR_2Y , wherein R is an alkyl having 1-16 carbon atoms and R may be the same or different and wherein Y is hydrogen or a halogen.

15. Method for optimising the supply of a catalyst slurry to a polymerisation reactor (1) wherein polyethylene is prepared, comprising the steps of:

- providing concentrated catalyst slurry consisting of solid catalyst particles suspended in a hydrocarbon diluent or in a mineral oil in one or more storage vessels,
- diluting said concentrated catalyst slurry for obtaining a suitable concentration for use in a polymerisation reaction, whereby said catalyst slurry is diluted while being transferred from said storage vessel to a mixing vessel, wherein said diluted catalyst slurry is maintained,
- optionally further diluting said catalyst slurry in said storage vessel, and
- pumping said diluted catalyst slurry at a controlled flow rate from said mixing vessel (3) to said polymerisation reactor (1) through one or more conduits (4), by means of a membrane pump (5), provided in each of said conduits (4).

16. Method according to claim 15 for optimising the supply of a catalyst slurry to a polymerisation reactor (1) wherein bimodal polyethylene is prepared.

17. Method according to claim 15 or 16, wherein said catalyst slurry is diluted with a hydrocarbon diluent to a concentration comprised between 0.1 and 10% by weight.

18. Method according to any of claims 15 to 17, comprising transferring said catalyst slurry from said storage vessel (2) to said mixing vessel (3) at a controlled flow by controlling the ratio between diluent and catalyst in the mixing vessel (3).

19. Method according to any of claims 15 to 18, further comprising bringing a suitable amount of co-catalyst into contact with the catalyst slurry before injecting said catalyst slurry to said reactor.

20. Method according to claim 19 comprising bringing a co-catalyst into contact with said catalyst slurry present in the conduit (4).

21. Method according to claim 19 or 20 comprising enhancing the contact time of said co-catalyst with said catalyst slurry in the conduit (4), by locally enhancing the volume of said conduit (4).

22. Method according to any of claims 15 to 21, comprising controlling the flow rate of said catalyst slurry from the mixing vessel (3) to the polymerisation reactor (1) by determining the concentration of a reactant, preferably ethylene, in said reactor (1).

23. Method according to any of claims 15 to 22, comprising continuously supplying said catalyst slurry from said mixing vessel (3) to said reactor (1) through conduits at a suitable flow rate.
24. Method according to any of claims 15 to 23, wherein said catalyst is a metallocene catalyst, preferably supported.
25. Method according to any of claims 15 to 23, wherein said catalyst is a Ziegler-Natta catalyst having general formula MX_n , wherein M is a transition metal compound selected from group IV to VII, wherein X is a halogen, and wherein n is the valence of the metal.
26. Method according to any of claims 15 to 25, wherein said co-catalyst is an organoaluminium compound, being optionally halogenated, having general formula AlR_3 or AlR_2Y , wherein R is an alkyl having 1-16 carbon atoms and R may be the same or different and wherein Y is hydrogen or a halogen.
27. Use of an apparatus according to any of claims 1-4, 7, 9-12 and 14 for preparing and optimising the supply of metallocene catalyst slurry in a polymerization reactor wherein polyethylene is prepared.
28. Use of an apparatus according to any of claims 1-2, 5-11 and 13-14 for preparing and optimising the supply of a Ziegler-Natta catalyst to a polymerisation reactor (1) wherein polyethylene, and preferably bimodal polyethylene, is prepared.